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Influence of seasonal factors in the earned value of construction

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Abstract

The objectives in each construction process can be multiple. However, the constructions have to be carried out under some restrictions concerning price and terms. They constitute some strategic and interdependent goals. In other words, “time is money”. Several papers support that seasonal effects influence the execution rate of construction. Thus, most of them try to improve the forecasts by evaluating and joining them to the planning, although always measuring their influence indirectly. In this paper, we suggest a methodology to directly measure the influence of the seasonal factors as a whole over the earned value of construction. Additionally, we apply it to a certain case study regarding the subsidised housing of public promotion in the Castilla-La Mancha region (Spain). It is worth mentioning that our results are clarified: we have calculated the average monthly production for each month a year with respect to the annual monthly mean. Moreover, the differences regarding the average monthly production we have contributed are quite significant, and hence they have to be taken into account for each earned value forecast so that a project becomes reliable.

Keywords: Seasonal factors, Earned value, Cash flows, Construction.

AMS 2010 codes: 00A69, 62-07, 62P30.

1 Introduction

By a seasonal factor, we shall understand any pattern which is repeated each year in the same month regardless of its cause. Such a concept was proposed by Granger (1979) [8], who also rated, according to the four broad groups, the following:

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- **Climatic factors:** They include different hours of light per day, different hours of sunshine, temperature fluctuations, cold spells, frosts, snow, heat spells, heavy rainfalls, storms, heavy winds as well as other weather variables having direct impact on the construction output. These factors will influence the output with different intensities depending on the stage of the project.
- **Calendar factors:** The number of actual working days that influence the monthly output is calculated as the difference between the number of days in a given month (28–31 days) and the number of public holidays. It is worth noting that the number of working days can vary greatly on a monthly basis.
- **Date factors:** They mainly refer to holidays. Although these factors are not related to any season at first glance, they have been made official by tradition. This is the case of summer holidays or Christmas, to name a few. Several building companies are then forced to stop the production over entire weeks since most of the local companies associated with that sector, such as suppliers, concrete makers, carpenters, locksmiths, plumbers and electricians, allow their workers to take vacations.
- **Expectation factors:** The expectation of a seasonal behaviour, although hard to be specified, may lead to actual seasonal effects concerning the output. Some examples include value-added tax (VAT) settlement dates, corporate tax payment, year-end dates for public enterprises accounting or the need to comply with both the output and the annual budget.

The four groups described above could be understood as the basic factors of seasonal nature that may influence the construction output. Although the factors regarding date, calendar and expectation are deterministic, the climatic factors are probabilistic at least partially.

It is hard to enumerate all the studies regarding the influence of seasonal factors in the construction output. As an example, Vitrubio (circa I b.C.), and Alberti and Palladio later, showed that several constructive tasks had to be carried out in certain seasons. The calendar factors are those that can be more easily incorporated into a construction planning, according to several works (Balkau, 1975 [1]; Bromilow & Davies, 1978 [4]; Khosrowshahi & Kaká, 2007 [13]).

Nowadays, all the computer packages for project planning automatically fit a timeless planning to a certain construction calendar including holidays. Further, holiday dates can be also added, although they must be known beforehand. The difficulty consisting on adding holiday dates to actual construction calendars bring to light in those countries where laws protect the right of holiday choice. In these cases, the calendar factor is no longer deterministic.

On the other hand, other authors (e.g., Tucker & Rahilly, 1982 [19]; Koehn & Brown, 1985 [14]; Chan & Kumaraswamy, 1995 [6]; El-Rayes & Mosehli 2001 [9]; Williams, 2008 [21]; Odabasi, 2009 [15]) have explored the climatic factor giving rise to some predictive models with varying success. Nevertheless, we have not found any studies measuring the influence of all the seasonal factors in the construction directly.

2 Methodology

The suggested methodology is novel and is based on the scientific empirical method, which is the one that supports statistics. The main goal of this paper is to directly measure how seasonal factors influence the earned value of construction. Thus, we analyse the actual output historical records from construction works. To deal with, it becomes necessary to have working units (by time unit) available. For instance, m³ of digging by time unit, m² of road surface by time unit, kg of frame steel by time unit, etc. However, observe that a comparative analysis involving a great number of different output units would make our research unfeasible. In this way, there exists an output unit that standardises all of them: the output measured in terms of monetary units by time unit. This will provide the field data, so that we shall collect and process to directly measure the influence of seasonal factors in the construction sector.

It is worth noting that developers pay for the carried out construction to builders in terms of hiring prices by time unit in most of the market economies in developed countries. This provides output data in monetary units which are compatible with the suggested methodology.

On the other hand, the methodology concerning the sample choice leads to setting the territorial, temporal and typological limits. Regarding territorial limits, it should be mentioned that the place where the construction is carried out has some seasonal conditions (climatic, cultural, legal, social, etc.) which is different from other places. For instance, northern hemisphere locations are rather different from southern hemisphere locations, due to obvious climatic reasons, among others. Regarding temporal limits, recall that in any productive process, it holds that time leads to noticeable changes concerning the qualities and types of production factors, the types and qualities of products as well as the productive process itself. Finally, regarding typological limits, notice that it becomes necessary, since the seasonal factors will influence differently the construction of tunnels, road surfaces, bridges or buildings. Several works support the above (Skitmore, 1992 [18]; Kaká & Price, 1993 [11]; Banki & Esmaeili, 2009 [2]; Ostojic & Radujkovic, 2012 [16]; Valderrama & Guadalupe, 2013 [20]; Heaps & Domingo, 2014 [10]).

Next, we shall provide some comments concerning monthly output data in terms of monetary units. Firstly, not all the constructions start in the first day of a given month. Indeed, it could start any day. Furthermore, some standstills and restarts may take place in any moment in a month. And obviously, we cannot assess the output in those dates when there is no production. On the other hand, the production costs may correspond to periods containing days from 2 or more months a year.

Our methodology needs to compare the productions in each whole month of the year. Hence, to deal with the problems mentioned above, we suggest to calculate the production having a linear distribution for each calendar day, by allocating or completing proportional productions for each whole month.

For example, if a construction site starts on 11th April, and it is also known that the production for that incomplete month is € 20,000, then we shall assign the whole month a production equal to $30 \cdot 20,000/20$. Another example is as follows. If we have a production of € 80,000 corresponding to 50 calendar days, and 31 of such days belong to July, then the July production is equal to $31 \cdot 80,000/50$.

Next step is to compare the output costs for each month a year among different promotions since each of them has a different price depending on its size. In this way, a comparison involving the gross production of a 12–housing promotion, and a 120–housing promotion, for instance, would not make sense. That issue will be solved by calculating the production percentage of the prices for each month. This makes the average monthly production for each promotion be the same in all its cases. In this work, we suggest it to be equal to 100%. To deal with, since there is an integer number of whole month certifications for each promotion (after carrying out all the required calculations as mentioned above), we shall apply the following equation for each certification in a same promotion:

$$\% \text{ production} = 100 \times \frac{\text{Number of months} \times \text{Month price}}{\text{Sum of the prices for all the promotion months}}$$

For illustration purposes, let us assume a construction site with a time-scale equal to 6 months and the monthly output prices are given in Table 1. Thus, if all the involved months had had the same production, then the average monthly production would be equal to € 20,000 ($120,000/6$), and it would be assigned a percentage average monthly production equal to 100%. This is the case of May. However, since the productions are different for different months, then they have different percentages of production. For example, the € 10,000 corresponding to March are assigned a 50% of the production, and the € 30,000 corresponding to July are assigned a 150% of the production. Further, since there are 6 values of monthly production, then all of them are equal to a total percentage of 600%.

Thus, all the monthly output percentages are comparable among them, regardless of the promotion they belong to, since all of them have an average monthly production of 100%.

It is worth noting that the change in percentage concerning the gross data for price and time constitutes a widely applied methodology by researchers focused on cash flows for the comparison purposes of different size

<i>Month</i>	<i>Price</i>	<i>Factor</i>	<i>Percentage</i>
March 2012	€ 10,000	$100 \cdot 6/120,000$	50%
April 2012	€ 15,000	$100 \cdot 6/120,000$	75%
May 2012	€ 20,000	$100 \cdot 6/120,000$	100%
June 2012	€ 35,000	$100 \cdot 6/120,000$	175%
July 2012	€ 30,000	$100 \cdot 6/120,000$	150%
August 2012	€ 10,000	$100 \cdot 6/120,000$	50%
Aggregate	€ 120,000	$100 \cdot 6/120,000$	600%

Table 1 Example of change in % of all the month production prices for a given promotion. Source: own elaboration.

and time scale promotions (Peer, 1982 [17]; Kenley & Wilson, 1989 [12]; Blyth & Kaká, 2006 [3]).

Following the above, the suggested methodological process is as follows:

- We shall demarcate the territorial area concerning a certain region or geographical area, so that there exist no significant seasonal differences among different construction locations.
- We shall demarcate the study temporal area so that we can collect historical data where there are no essential changes regarding factor or productive models.
- We shall demarcate the productive typology in order to guarantee the seasonal influence which is essentially the same in all the similar productive processes.
- We shall work with a database “wide enough” consisting of historical values regarding monthly production for whole months in terms of monetary units. The expression “wide enough” will be given in terms of the sampling errors we shall accept.
- In order to properly compare the productions from different size and different term constructions, we shall measure the percentage of the production for each month with respect to an average monthly production of 100% for each promotion.
- The calculated percentage data will allow a summary statistical study, an analysis regarding atypical values, and a Student’s t-test to decide whether the data (with and without atypical values) belong to a same cohort.
- Then we shall calculate the average productions for each month throughout the cohort data, which will lead to a seasonal index for each month. Hence, we shall calculate the average percentage production for each month via the next equation:

$$\bar{X} = \frac{\sum_{i=1}^n X_i}{n}$$

where \bar{X} denotes the mean production for each month, X_i corresponds to the historical percentage productions in that month, and n refers to the number of months.

3 Case study and results

The field work concerning this case study was planned in order to collect the costs, those dates regarding regular certifications of public promotions for Castilla-La Mancha (Spain) subsidised housing, as well as the work start dates and standstills.

Each certification, according to Spanish Laws, consists of the output value for each certified month in terms of contract prices.

Thus, the statistical analysis we carried out is based on the following key concepts:

- **Sample unit:** Each of the public promotions for subsidised housing corresponded to both territorial and temporal study fields. A total amount of 161 sample units were considered in this work. Further, it is worth mentioning that the size of the sample units was not uniform since there exist promotions from 3 to 170 housing. In this way, we shall refer to both the number of promotions and the number of housing for sample size determination purposes with respect to the settlement. Thus, 5,319 housing were assigned to the 161 sample units.
- **Case:** Each of the regular certifications was paid by developers to builders and made for all the sample units. Each case contains the following data for each certification: ordinal number, cost (in €), and both the corresponding month and year. In this study, there are works containing 9–37 non-void certifications. We have 3,076 cases.
- **Territorial field:** This study has been carried out in the regional field of Castilla-La Mancha (Spain) which consists of 5 provinces. The analysed promotions are settled down in 107 townships.
- **Temporal field:** Defined as the period where the studied promotions have been carried out. They span from 1999 to 2012.
- **Cohort:** All the public promotions for subsidised housing that were carried out in both territorial and temporal study fields.
- **Sample choice:** There has been no sample choice in this study since our goal herein was to study all the cohorts in order to avoid the sampling error and to consider all the information available, as well.
- **Sample:** The sample size regarding this study is equal to 161 sample units having a total amount of 5,319 subsidised housing, as it was previously stated. However, due to the lack of permission concerning some promoters, we could not study the whole cohort. Despite this, we have achieved a sample large enough, as summarised in Table 2.

<i>Units</i>	<i>Cohort</i>	<i>Sample</i>	<i>%</i>
Provisional gradings for both public and private subsidised housing (October 98/June 12)	45,175	5,319	11.77
Final gradings for both public and private subsidised housing (Feb. 00/Feb. 13)	37,665	5,101	13.54
Public subsidised housing (99/12)	6,886	5,319	77.24
Public subsidised housing promotions (99/12)	192	161	83.85

Table 2 Sample and cohort concerning Castilla-La Mancha (Spain) subsidised housing. Source: own elaboration.

Thus, we can affirm that the sample lies between 11.77% and 13.54%, provided that we assume that the cohort contains the number of both public and private subsidised housing. On the other hand, whether we assume that the cohort consists of either the number of public promotion subsidised housing or the number of promotions of subsidised housing of public promotion, then we obtain that the sample exceeds 77%.

- **Sampling errors:** They have been calculated throughout the following expression (Del Castillo, 2008 [7]), by assuming a level of confidence equal to 95%:

$$e = \sqrt{\frac{k^2 pq(N - n)}{n(N - 1)}}$$

where e denotes the sampling error, and k is a constant which depends on the confidence level. In this way, several values for k are displayed next for different confidence levels (Table 3):

<i>k</i> values	1.15	1.28	1.44	1.65	1.96	2.00	2.58
Confidence level	75%	80%	85%	90%	95%	95.5%	99%

Table 3 k -values for different confidence levels.

In this case, the value of k has been chosen to be equal to 1.96 since we are assuming a confidence level equal to 95%. In addition, observe that p (respectively q) is the probability that the studied event may (respectively not) happen. In this case, we have chosen $p = q = 0.5$, which are those that throw a larger error. Further, n denotes the sample size, and N is the cohort size. The obtained errors are summarised in Table 4.

<i>Units</i>	<i>Cohort</i>	<i>Sample</i>	<i>%e</i>
Provisional gradings for both public and private subsidised housing (October 98/June 12)	45,175	5,319	1.26
Final gradings for both public and private subsidised housing (Feb. 00/Feb. 13)	37,665	5,101	1.28
Public subsidised housing (99/12)	6,886	5,319	0.64
Public subsidised housing promotions (99/12)	192	161	3.11

Table 4 Sample errors. Source: own elaboration.

Next step is to assess the reliability concerning the forecast that could carry out through the previous results. To deal with, we shall describe the most relevant statistical data along this study as well as other analyses developed by removing atypical values.

In this way, Table 5 contains the values regarding summary statistics after incomplete month outputs were completed and converted into percentages.

It is worth noting that the standard deviation is too large 0.678 (67.8%) with respect to the mean, which is equal to 1.00 (100%). Moreover, observe that the maximum value is close to 6 (600%), the obtained kurtosis is higher than usual, and also the asymmetry coefficient is too high, as shown in Figure 1, which displays a right distribution bias.

Based on the previous results, two studies were carried out: the first one by removing the strict atypical values, and another one consisting of removing the slight atypical values, as well.

By strict atypical values, we shall understand those being away 3 times the interquartile range from left with respect to the first quartile, and from right with respect to the third quartile, respectively, where the interquartile range is the difference between the third quartile and the first quartile, as usual. In this case, the interquartile range was found to be equal to 0.793 (79.3%). In addition, the limit of the left strict atypical values is calculated as the difference between the value of the first quartile (53.1%) and three times the interquartile range. On the other hand, the limit of the right strict atypical values is calculated as the sum of the third quartile (132.2%)

<i>Mean</i>	1.000
<i>Standard Error</i>	0.012
<i>Median</i>	0.901
<i>Mode</i>	1.342
<i>Standard deviation</i>	0.678
<i>Sample variance</i>	0.460
<i>Kurtosis</i>	5.779
<i>Asymmetry coefficient</i>	1.637
<i>Range</i>	5.951
<i>Minimum</i>	0.001
<i>Maximum</i>	5.953
<i>Sum</i>	3.076
<i>Confidence level (95%)</i>	0.024
<i>1st quartile: Q₁</i>	0.531
<i>3rd quartile: Q₃</i>	1.323
<i>Interquartile range: Q₃ – Q₁</i>	0.793

Table 5 Summary statistics for percentage certification data. Source: own elaboration.

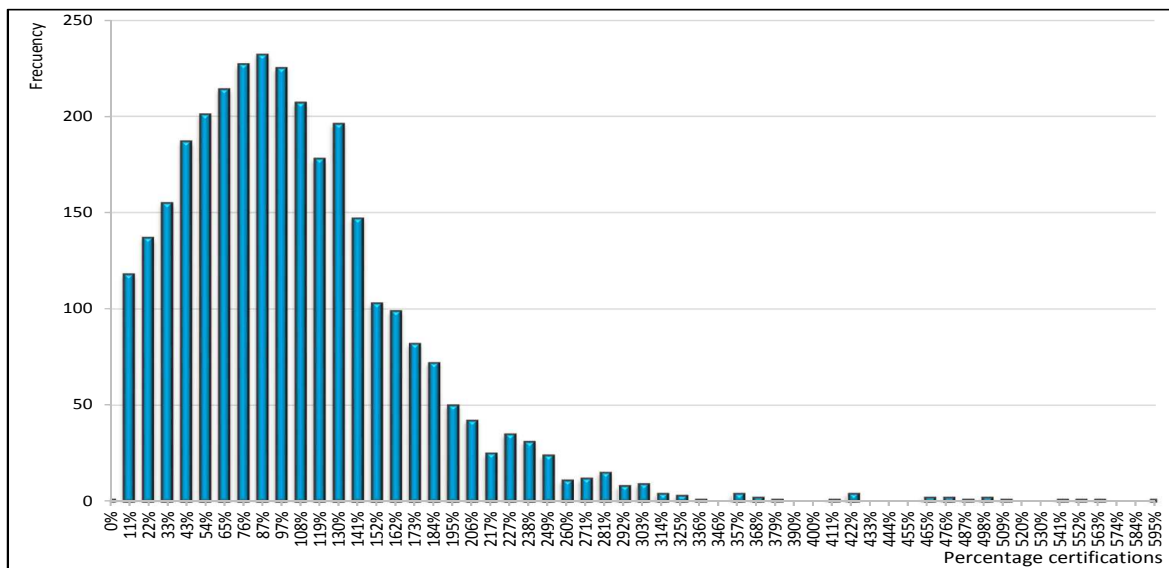


Fig. 1 Frequency histogram for percentage certifications. Source: own elaboration.

plus three times the interquartile range. Thus, the limits were found to be equal to -184.4% (left) and 369.7% (right).

Notice that we have removed 18 extreme values (higher than 369.7%) from the right, whereas no value has been removed from the left (since there are no negative outputs). Similarly, by adding and subtracting 1.5 times the interquartile range, we have calculated the slight atypical values. To deal with, we have removed 84 output extreme values (higher than 251.0%) from the right.

Figure 2 shows the comparison of the monthly mean outputs calculated through data from completed certifications, data without extreme atypical values, and data without slight atypical values. Thus, it holds that there are clearly differences regarding the monthly mean outputs but the trends in the graphics remain throughout the months.

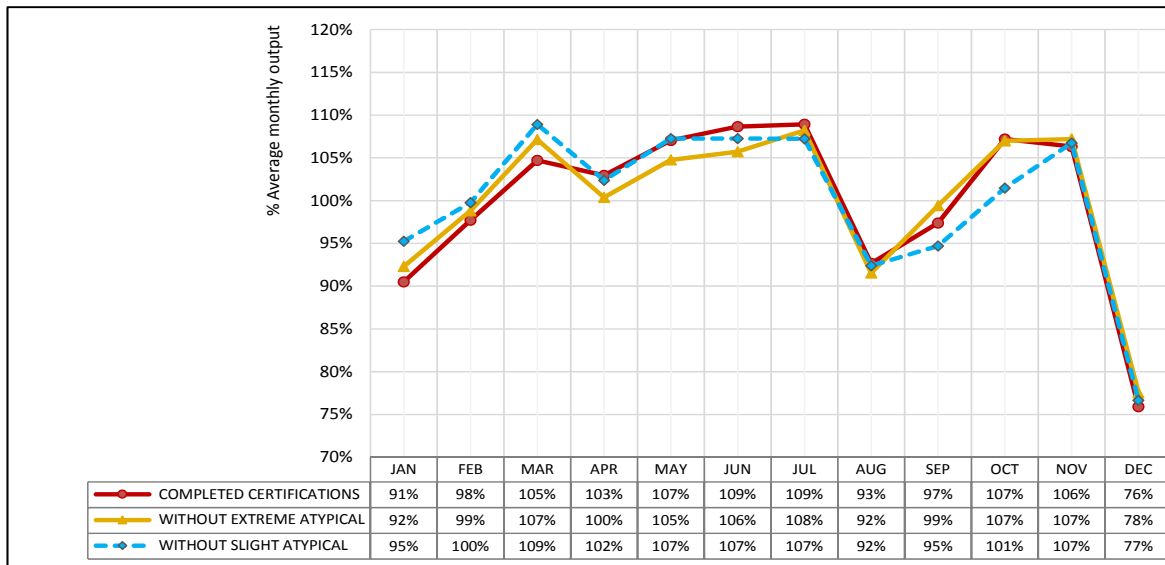


Fig. 2 Percentage of the monthly mean output involving data from completed certifications, data without extreme atypical values, and data without slight atypical values. Source: own elaboration.

To check out what was graphically displayed in Figure 2, we shall carry out a Student’s t-test involving two samples, under the assumption that the standard variances are not equal and by a confidence level equal to 95% (Carlberg, 2012 [5]).

The calculations have been carried out using data from October, the month which displays a larger output difference. They threw a t-statistic value equal to 0.014 as well as a tail probability equal to 49.5%, which gives a value much higher than the probability to reject the null hypothesis under the assumption it is true. Hence, we can confirm that the two samples come from the same cohort and also that the atypical values will not influence noticeably the results.

However, we think that the problem is not to factually determine the atypical values from a dataset (e.g. via the calculation of the interquartile range) but to explain why certain values can be understood to be atypical, and in such a case, whether it becomes necessary to remove them from the statistical analysis.

In this way, our criterion is to study all the gross data by the least possible treatment. Thus, the results provided next have been obtained without removing atypical values.

In fact, following the methodology, we have completed those certifications corresponding to incomplete months proportionally, and then we have calculated the percentage of the output for each certification for comparative purposes, regardless of the size of the corresponding promotion. Table 6 shows the number of certifications studied per month. Hence, it holds that the number of certifications is large enough in terms of mean output, with a mean equal to 256.3 certifications per month, and a standard deviation equal to 6.1, respectively.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
244	254	260	260	263	262	262	260	259	250	252	250	256.3

Table 6 Number of certifications per month. Source: own elaboration.

Moreover, Table 7 provides a re-count concerning the number of months corresponding to each quarter-term of works project implementation. This has been carried out to guarantee the distribution of the months happens in all the work stages.

In this work, we are not especially interested in how to measure the influence level of each group of the

MONTH	< 25%	25% – 50%	50% – 75%	75% – 100%	SUM
JAN	57	60	71	56	244
FEB	61	55	73	65	254
MAR	64	60	70	66	260
APR	58	64	68	70	260
MAY	63	66	61	73	263
JUN	67	58	59	78	262
JUL	70	59	61	72	262
AUG	62	71	56	71	260
SEP	60	66	61	72	259
OCT	52	76	51	71	250
NOV	49	81	54	68	252
DEC	47	77	60	66	250
MEAN	59.2	66.1	62.1	69.0	256.3

Table 7 Number of certifications per month and terms of works project implementation. Source: own elaboration.

seasonal factors separately. However, we can still explore some of them. Thus, next, we explore the effect caused by the calendar factors for the term when the studied promotions are developed.

All the holidays of paid character and unrecoverable are officially stated, including national, regional, and local holidays for each year. On the other hand, the collective bargaining agreements and the construction agreements set the working calendars yearly. For all the years in the present study, they consist of 5 days a week, from Monday to Friday (both included).

Table 8 summarises the number of working days per month and year. They have been calculated after excluding holidays from the number of calendar days for each month.

99	00	01	02	03	04	05	06	07	08	09	10	11	12	MONTH
19	20	22	22	21	19	20	21	22	21	20	19	20	21	JAN
20	21	20	20	20	20	20	20	20	21	20	20	20	21	FEB
22	23	22	18	20	22	20	22	22	18	21	22	23	22	MAR
20	18	19	22	20	20	21	18	19	22	20	20	19	19	APR
20	21	22	21	21	20	21	21	21	21	20	20	21	21	MAY
22	22	21	20	21	22	22	22	21	21	21	22	21	20	JUN
22	21	22	23	23	22	21	21	22	23	23	22	21	22	JUL
22	22	22	21	20	22	22	22	22	20	21	22	22	22	AUG
22	21	20	21	22	22	22	21	20	22	22	22	22	20	SEP
20	21	22	23	23	20	20	21	22	23	21	20	20	22	OCT
21	21	21	20	20	21	21	21	21	20	21	21	21	21	NOV
21	18	19	20	21	21	19	18	19	21	20	21	20	19	DEC

Table 8 Number of working days per year and month throughout the period of study 1999-2012 for construction companies (Monday to Friday included). Source: own elaboration from “Diario Oficial de Castilla-La Mancha” (Spain) and “Convenios Generales del Sector de la Construcción en España”.

Figure 3 shows some effects of the calendar factor (in %), by assuming a mean month of 100% working days (see dotted line therein). Thus, under the assumption that monthly output depends on the number of working days, there is a maximum difference equal to 10% among the least and the most productive months, due to the

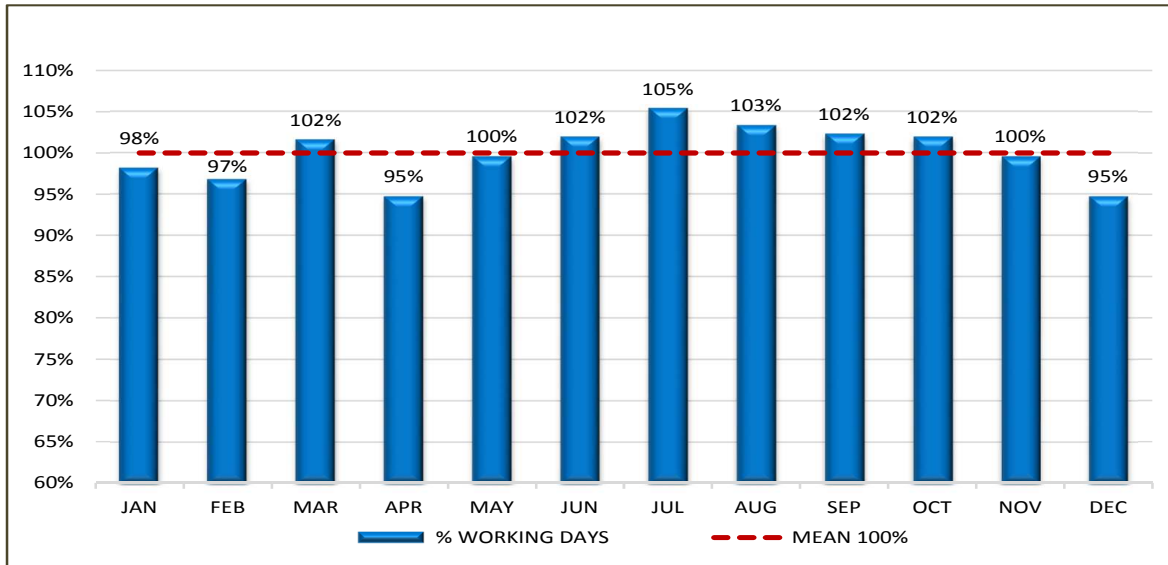


Fig. 3 Percentage of working days per month in the period 1999-2012. Source: own elaboration.

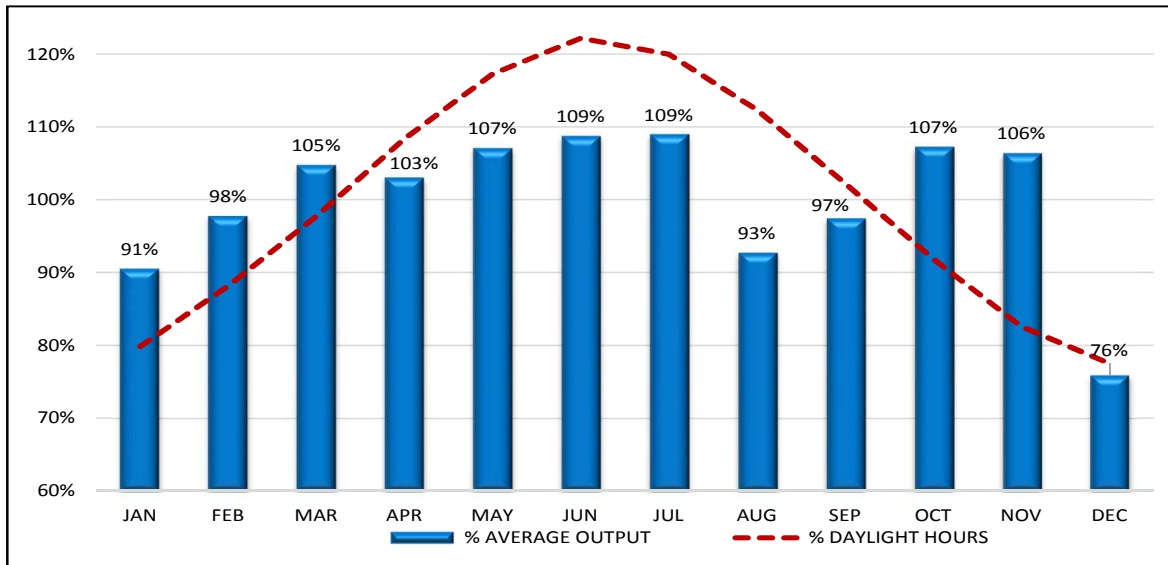


Fig. 4 Percentage of monthly mean output and percentage of monthly mean daylight. Source: own elaboration.

calendar factor.

Additionally, the average of light hours a day per month as well as the monthly percentage has been measured, by assuming a mean month of 100% hours with light. It is worth mentioning that the city of Albacete (placed in the heartland of the mean latitude of Castilla-La Mancha) and the 15th day of each month have been selected for calculation purposes. In this way, Figure 4 shows the results obtained as a consequence of the previous calculations. The histogram of frequencies regarding the percentage of the monthly mean output reflects the influence of the seasonal factors as a whole.

However, neither the calendar effects nor the monthly daylight hours allow to explain themselves the output differences, although they could explain several of the above mentioned issues.

For instance, observe that the months ranging from January to March follow a similar progress to the percentage of the daylight hours, without forgetting that other (holiday, climatic, and calendar) factors also affect. On the other hand, the slight output descent in April is mainly due to the effect of the Easter week holidays. In fact, April would have a similar output to May, June, or July outputs provided that a 5% is added to April output (namely, the percentage that separates April from May due to calendar effects).

Furthermore, the low August and September outputs are mainly due to the holiday factor. Likewise, as we advanced previously, local construction companies usually close for a week (or even for 2 weeks) due to Castilla-La Mancha August and September local festivities.

It is also worth mentioning that the grape harvest plays a key economic role in Castilla-La Mancha September output which makes this fact to influence the (lower) output throughout that month.

Additionally, if we consider the summer solstice (which takes place around 21st June) as a symmetry axis, then it holds that the October output is slightly higher than the output of its seasonal symmetric March, although quite similar, anyway.

That viewpoint hardly explains the high November output. Nonetheless, let us take a look at the expectation factors. Indeed, notice that the November certification is the last involved in the tax year, and also that the pressure to reach the output goals as well as the assigned budgets becomes maximum. On the other hand, the certification concerning December is taken into account the next annuality.

December is the least productive month since all the factors influence it adversely. More specifically, we can quote its allowance with respect to the next year's budgets, climatic and calendar factors, and vacational factors. In particular, the vacational factors are maybe the most relevant, since the companies often regularise their holiday period debts with workers before the yearly close in December, and sometimes, during the first days in January next year.

The previous arguments provide only a possible reason regarding the output monthly differences based on the results and the work experience, as well. In this way, the suggested hypothesis must be supported by further in-depth studies regarding all the possible causes separately, their combinations, and their possible effects (singly and jointly), as well. Anyway, it holds that the seasonal factor effects lead to significant monthly output differences that will be reflected in the corresponding output curves, and hence, in the cash flow estimates.

4 Discussion and conclusions

In this paper, we deal with the following research issue: Do seasonal factors influence the profits in construction projects? It seems that an affirmative answer is obvious. In fact, all the conditions are equal, and it is clear that the outcome becomes higher in those months having a large number of working days than in months with a smaller number of working days, and that the outcome becomes lower in bad weather and stormy days than in quiet, warm, and fair-weather days, to quote some examples.

In the literature review carried out, we have verified that most of the research works have accepted the evidence described above and have tried to assess and incorporate the influence of seasonal factors in the outcome forecasts and cash flow estimates, though partially and indirectly.

However, we have checked the evidence by measuring the influence of all the seasonal factors directly and to deal with, we have contributed a methodology easy to be applied in a case study.

Regarding the case study, it was designed according to the premises in the methodology under territorial, seasonal, and typological restrictions. It is worth mentioning that our sample is wide enough to minimize the sampling errors.

In this work, we have not only highlighted the influence of the seasonal factors but also objectively measured them. For that purpose, we have considered 3,076 monthly output data with an average greater than 250 monthly data for each month a year. Observe that the average monthly output for each month a year only can be influenced by the seasonal factors since other ones that may affect the time series, such as trends and random components, do not present a serial order and remain unavailable when comparing months from different years.

The quantification concerning the seasonal factor influence throughout the historical records allows to affirm that, for instance, July, which is the most productive month, becomes 43% more productive than December, which is the least productive month. In addition, June, which consists of 30 calendar days, becomes 20% more productive than January, consisting of 31 calendar days. These changes, obviously, will influence directly the cash flow estimates. Let us assume, for instance, that it has been arranged a construction where the results of this case study can be applied. Further, as a result of the planning, we have a 12-month execution period, as well as a constant cash flow of €100,000 each month. Thus, a new non-constant cash flow will follow in terms of the seasonal factors (for each month) as a consequence of the updated calendar planning and the application of the finds, as well. Accordingly, if the construction starts on 1st June, then the outcome forecast for each month will be equal to €109,000, while if the construction starts on 1st December, the outcome forecast for that month will be equal to €76,000.

We would like to conclude that the seasonal factors do influence noticeably the cash flows of the constructions and hence, have to be taken into account for construction planning purposes. In this way, if there exist no relevant changes regarding the construction production processes, then the analyse based on the outcome historical records by distinguishing geographical areas and constructive typologies can allow to easily improve the reliability of the forecasts.

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